HENDERSON

WATER AND STEAM HEATERS

THE

Prizer-Painter

STOVE & HEATER CO.

P & H

READING, PA.

NEW YORK OFFICE

160 Fifth Avenue

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WORKS OF THE PRIZER-PAINTER STOVE & HEATER CO., READING, PA.

HEATER CATALOGUE NO. 4

HENDERSON THERMO

WATER AND STEAM

HEATERS

MADE BY

THE PRIZER-PAINTER STOVE & HEATER CO.

CHARLES S. PRIZER, PRESIDENT
ENOCH T. PAINTER, VICE-PRESIDENT

A. T. HENDERSON, SECRETARY
RALPH L. MCCALL, TREASURER

FACTORY AND HOME OFFICE

READING, PA., U. S. A.

BRANCHES

NEW YORK BOSTON CHICAGO DETROIT PHILADELPHIA ST. PAUL

We sell only to
heating contractors

No. 719 HENDERSON THERMO WATER HEATER

Showing the complete heater

No. 728 HENDERSON THERMO WATER HEATER

Showing the complete heater

No. 741 HENDERSON THERMO WATER HEATER

Showing the complete heater

HENDERSON THERMO WATER HEATER.

We ask the heating contractor and the house owner who is about to select a heater, to read this book. The Henderson Thermo heater marks a distinct advance in heater construction. It embodies new features of decided value to the user, and every fitter will appreciate the many points which lessen the time and labor required to set up the heater.

We have endeavored to have our engravings show the details of construction as fully as possible, but engravings alone, however complete, cannot indicate why certain forms of construction are superior. We are confident that a careful reading of the text in connection with the engravings, will convince the unprejudiced that this heater has the good qualities of all others and many excellent features of its own.

We first designed the best heater that long experience and a thorough familiarity with all preceding constructions enabled us to devise. Then we designed special foundry equipment and special machinery that enables us to make this heater at as low cost as those of the most inferior design, and to offer the best heater that can be built at the price of the ordinary kind. It also enables us to adopt the interchangeable plan of manufacturing which saves time and annoyance in putting the heaters together, relieves all parts from the undesirable strain due to forcing them to their places, and makes it possible at any time to furnish new parts that shall be exact duplicates of the originals.

No. 741 HENDERSON THERMO WATER HEATER

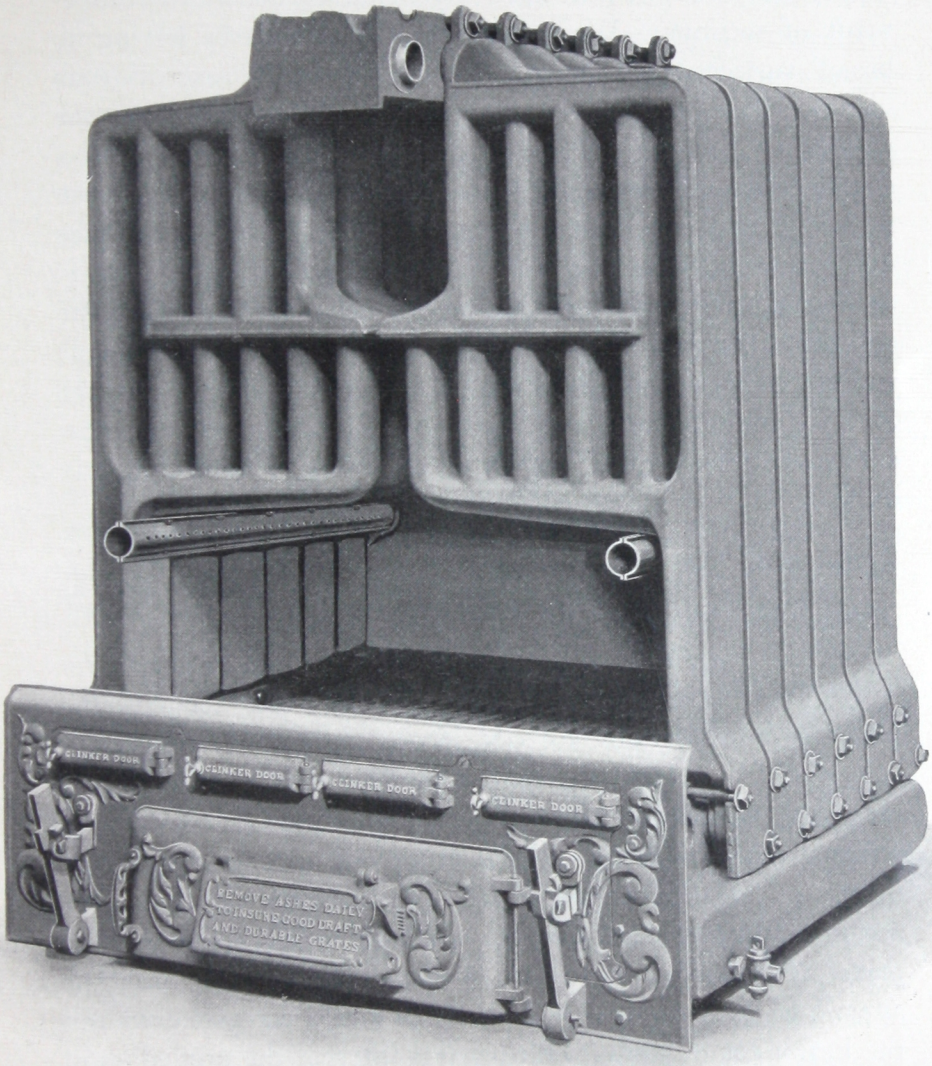
Half of the plate front removed, showing front water section

The Sections. The intermediate section consists of vertical water-tubes connected by three horizontal water-ways. When the heater is set up the sections meet at their outer edges and top water-ways, forming the walls of the heater, and, at the middle water-way, forming a crown sheet or roof for the combustion chamber. The middle water-way does not extend clear to the outside of the section, but leaves a vertical flue space on each side of the heater for the smoke to pass upward. The overhanging portion of a section, below the middle water-way, does not touch the adjoining section on the same side of the heater. There is a space of two inches between them, making all the surface below the crown sheet direct surface, and providing openings for the gases to pass from the combustion chamber into the vertical flues. See page 13.

The water tubes connecting the middle and top water-ways are in straight rows from front to back of the heater, but across the heater they are "staggered" as shown in the engraving on page 19, so that the gases, in passing from the upper vertical flues to the central flue, are compelled to go around the water tubes.

The front and back sections are practically intermediate sections changed to form the front and back walls of the fire-pot, with the necessary openings for doors, smoke-pipe, etc., and like the sections, are entirely filled with water. If they were cut in two vertically the inner halves would be exact duplicates of one-half of the intermediate section similarly cut. The outside half of the front is shown in the engraving on page 7, while that of the back is shown on page 29.

Many heater sections are so shaped that broad flat surfaces in adjoining sections come in contact. In time the rust which forms between these surfaces forces them apart irresistibly. This is a frequent cause of broken sections because a section must break or move. If the sections are strong enough to resist breakage nipple connections must be strained or



No. 741 HENDERSON THERMO WATER HEATER

Plate front and front water sections removed

broken. So great is the force exerted that in some cases nipples of wrought iron have been sheared off by the movement of sections. We avoid all such trouble by having no broad surfaces in contact. A small bead is cast on each section where it comes close to the adjoining section (see page 9). But even the beads do not meet. There is always a space of from a sixteenth to an eighth of an inch between them. This space is filled with furnace cement and the outer surface of the heater covered with asbestos plaster. Sufficient rust to strain the parts can never form between the sections. But even if such a force could be exerted no damage would result because the twin section construction and the form of our connections are expressly designed to allow sufficient movement of the parts to ease all strains from any cause.

Advantages of the Twin Section Construction.

In heaters made up of horizontal sections, as well as those of the vertical sectional type whose sections extend across the entire heater and form both sides of the fire-pot, the sections are cast in one piece. There is such a lack of freedom for the parts to expand that they are almost certain to crack when subjected to any unusual strain, such as would be caused by uncommonly heavy firing on cold days, and, in the case of steam heaters, the accidental loss of water and the consequent overheating of the parts. In many constructions such a mishap would make the apparatus useless until new castings could be procured and the heater remounted. During this interval the occupants of the building would suffer the discomforts of a cold house or incur the expense of providing temporary heat. In some cases circumstances necessitate the purchasing of a new heater. With a Henderson Thermo heater this delay, inconvenience, discomfort and expense would be avoided. The sections, being in two castings and not made to fit tightly, are so free

to expand that it is next to impossible to break them even with the most severe misusage. If, however, a section should break the heater can be temporarily repaired by a steam-fitter, machinist, or even the handy man employed in most manufacturing institutions. This is done by drawing the water out of the apparatus, disconnecting the broken section, plugging the upper and lower nipples with wooden plugs and a little white lead, and then putting the section back in its place. The heater is then ready for use, with one section less of heating surface, but in every other respect as good as ever. These temporary repairs can be made so quickly that the building will not have time to get uncomfortable.

The expense of making the temporary repairs will be much less than with the old style heaters. The sections, extending only half way across the heater, weigh less than half as much. They can be ordered by mail, shipped by freight and put in when most convenient. As all parts of the heater are made on the interchangeable plan, a new section or other casting may be purchased ten years after the heater is made, with absolute certainty of its fitting perfectly in place of the old one.

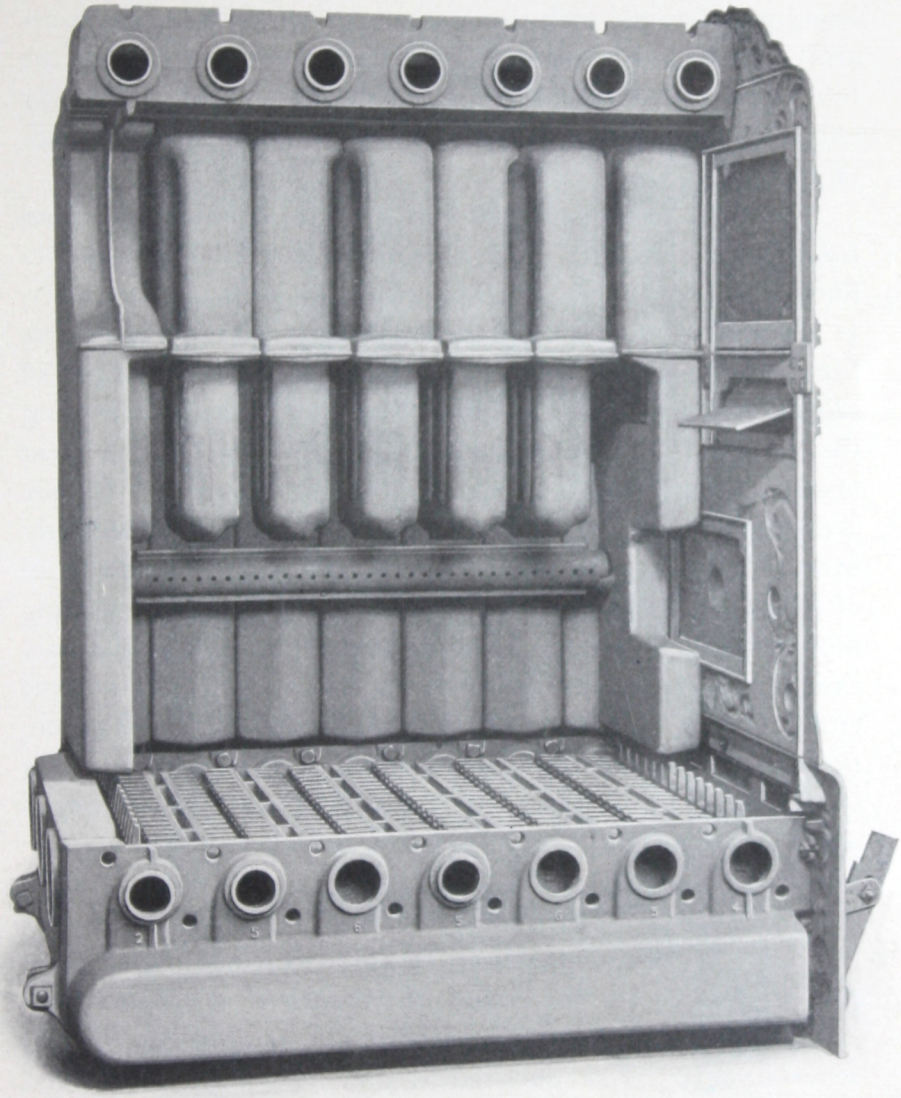
The entrances to basements of buildings in which heaters are placed are frequently so small and circuitous that they will not admit heater sections cast in one piece, much less those heaters of the single casting type. Frequently basement walls must be cut away to allow the heater to be taken through. This is never necessary with the Henderson Thermo heater. The section in the largest size is only 24 inches wide, 58 inches long, and 6 inches thick. It can easily be handled by a man and his helper and can be carried through any opening which a man can enter. Another important advantage of the twin section construction is that, the sections being free to expand, there is no strain on the joints to make them leak.

The Top Header. Between the upper ends of the sections a longitudinal top header is placed, as shown by the engraving on page 19. It forms a receptacle in which the water from all the sections is collected, and from which the flow pipes carry the water to the radiators.

The placing of the top header between the sections instead of above them, as commonly done, has many advantages. It makes it possible to increase the height of the sections, and consequently the area of fire surface, without exceeding the total height of heaters with outside headers; to use the slip nipple connection in both upper and lower joints; to utilize the top header as the roof of the central flue and its under side as fire surface.

The Smoke-Flues. In heaters of the vertical sectional type the openings for the products of combustion to pass from the combustion chamber into the heater smoke-flues are commonly placed at the back of the combustion chamber, thus drawing the heat toward the back of the fire-pot, and making the direct surface of the front sections less effective than that of the rear ones. The illustrations on pages 17 and 19 show how we have provided against this by locating the openings at both sides of the combustion chamber. The gases pass upward through the spaces between the sections, into the vertical smoke-flues on either side of the heater. Striking the top horizontal waterway they turn at right angles and travel laterally to the longitudinal flue and through it to the smoke-pipe.

The gases, in passing from the vertical flues to the central flue, strike the water surfaces of the vertical tubes at right angles. The tubes being "staggered" the gases not only follow a zigzag route but are compelled to come in contact with all the surface in the vertical tubes and in the middle and top water-ways, and are retained in contact with them until the water surfaces absorb more heat than is possi-



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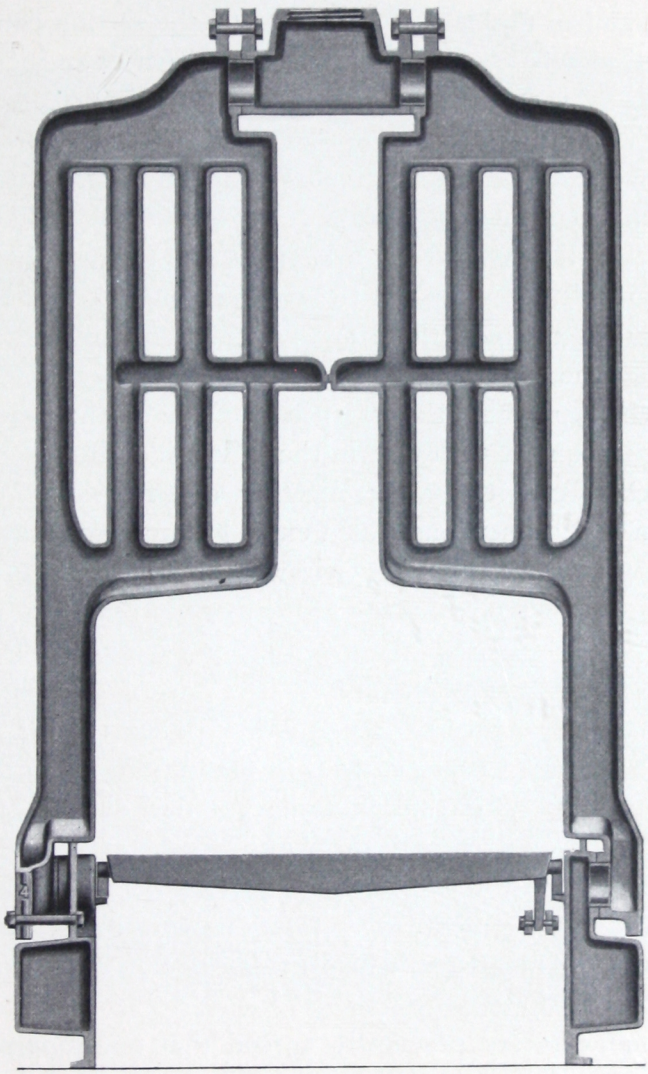
Front, back and intermediate sections on one side removed

ble with any other construction. The area of the lateral flues being proportional with the area of the central flue, the gases are compelled to pass through all of them, distributing the heat equally among all the sections, making them all equally effective and ensuring perfect combustion all over the surface of the grate.

In none of the sectional heaters in which the flues extend from front to back is there a uniform proportion of smoke-flue, fire surface and grate surface for all sizes of the heater. It is common practice to make as many as six sizes of heaters from sections of the same size, by increasing the number of sections. This simply lengthens the flues without increasing their area at all. The flue openings in the sections must necessarily have sufficient area for the largest heater. If they are properly proportioned in any one size they manifestly must be wrong in the other five sizes. In heaters made up of round flat sections several heater sizes are made by putting more sections above the same sized fire-pot. Here the only thing increased is the fire surface. There is no enlargement either of flue area or of grate. In the Henderson Thermo heater, as the flues are lateral, when a section is added a smoke-flue and a grate bar are also added, maintaining a uniform proportion of grate surface, fire surface and smoke-flue in all sizes.

Circulation. There has been much discussion in past years over the value of vertical as compared with horizontal circulation of water in steam and water heaters. The question is now practically settled and the disinterested heating engineer acknowledges the superiority of the vertical circulation. Perhaps the best evidence on this point is the fact that nearly if not all the heaters designed by experienced manufacturers during the past five years or more are of the vertical sectional type.

In the Henderson Thermo heater the circulation of



HENDERSON THERMO WATER HEATER

Showing the circulation of the water and the slip nipple water joints

water is wholly vertical except where it passes through the nipples connecting the sections with the water base and top header, and in the horizontal parts of the section connecting the vertical tubes. The latter have so much of an incline and the distance is so short that there is practically no obstruction to the circulation. The nipples have large water-ways, are only one and one-quarter inches long and offer little or no obstruction to the flow of water.

Other features which materially aid the free circulation of water are the dividing of the sections into a series of small water tubes in which there are no counter currents, and the casting of the sections in two pieces, one on each side of the grate, which prevents the water in one side of the heater from coming in contact with that in the other side, thus eliminating the friction caused by the meeting of the two currents of water in vertical sections which extend clear across the heater. The engraving on page 15 clearly illustrates these features and shows their advantages more forcibly than any possible description.

Fire Surface. Fire surface is either direct or flue surface. Direct surface is that upon which the light from the incandescent fuel shines; and flue surface that upon which the light does not shine. The relative value of the two kinds of surface depends upon their shape and arrangement, their location with reference to the grate, and the manner in which the gases of combustion come in contact with them.

Engineers are practically agreed that one square foot of direct fire surface, in boilers as usually constructed, is equivalent to three feet of flue surface. Then why not have all the surface direct? Simply because the burning gases would pass over it so rapidly that the surface could not extract a proper proportion of their heat, and a large amount would pass unused to the chimney and be wasted. Flue surface properly

No. 741 HENDERSON THERMO WATER HEATER

Plate front and front water sections removed. The surface in contact with the red flames is all direct fire surface.

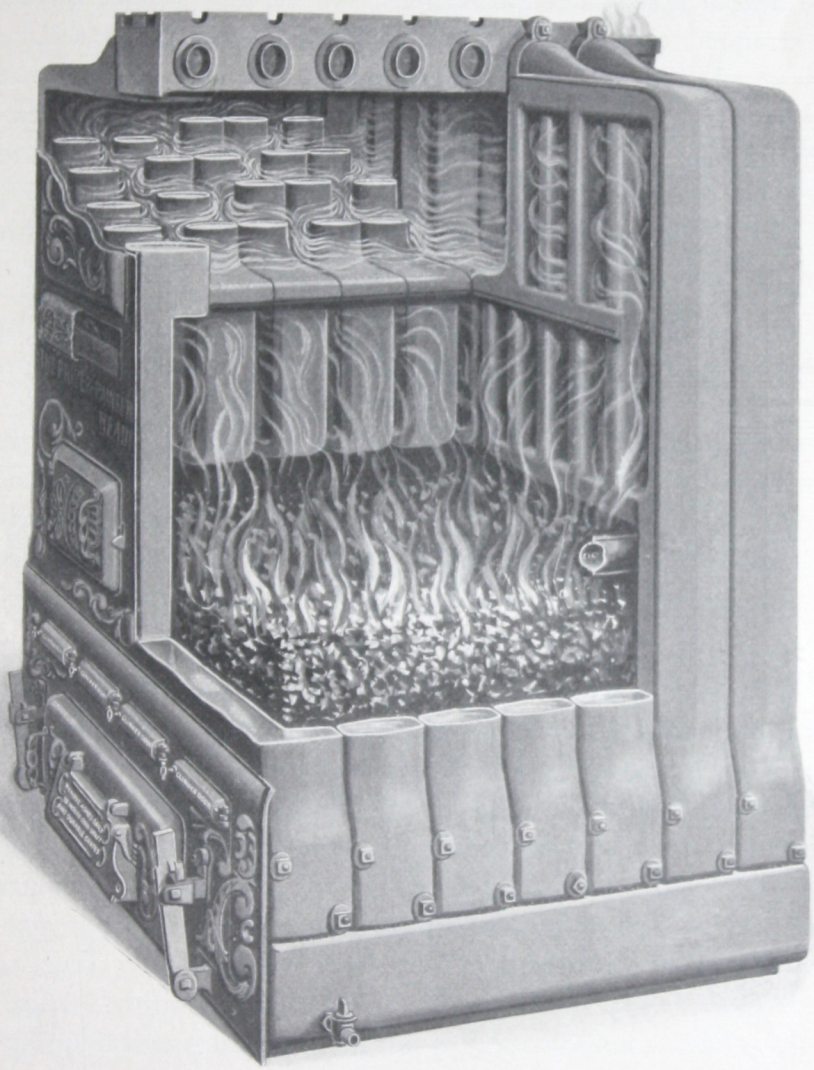
disposed retards the flow of burning gases to the chimney and retains them longer in contact with both direct and flue surfaces. Without flue surface the direct surface could not develop its full efficiency.

While we must have flue surface to obtain the best results, it has been conclusively shown that its extension beyond certain limits not only renders the excessive surface valueless for extracting heat from the gases, but actually makes the whole heater less effective. The proper proportioning of direct and flue surface is, therefore, a very important consideration and directly affects the results to be obtained from a given quantity of fuel.

The engravings on pages 9 and 17 show the relative proportions of direct fire surface, flue surface, fire-pot and combustion chamber. The space between the grate and the under side of the gas consumer tubes is the fire-pot and is usually filled with coal. From the top of the coal to the middle horizontal water-way of the sections is the combustion chamber. Our experience has demonstrated that a combustion chamber of this height is necessary for the proper mixing and burning of the gases. All the fire surface between the grate and the top of the combustion chamber is direct surface. By introducing the overhanging portions of the sections into the combustion chamber we largely increase the direct fire surface without increasing the total height of the heater or diminishing the efficiency of the combustion chamber. Moreover, this surface, enveloped as it is by the burning gases, is the most effective that has ever been devised.

Advantages of Vertical Fire Surface.

It is sometimes contended that vertical fire surfaces transmit less heat than horizontal surfaces to the water behind them. While vertical surfaces may be so constructed as to be less effective than horizontal ones, the statement is by no means true of all vertical surfaces. The



No. 741 HENDERSON THERMO WATER HEATER

Showing how the draft, after rising above the crown sheet through the side vertical flues, passes horizontally against and around the vertical tubes and into the central flue under the top header

effectiveness of horizontal surface is due solely to the fact that the heat strikes it at right angles. If vertical surface is also so arranged that the heat strikes it at right angles, it will be just as effective as horizontal surface. This is precisely what we have done with most of the vertical surface in the Henderson Thermo heater. Above the middle water-ways of the sections, the gases strike squarely against the vertical tubes, and below the middle water-way the gases travel parallel with only a small portion of the vertical surface.

Now compare the horizontal surface in the Henderson Thermo heater with that of one in which a horizontal section forms the roof of the combustion chamber. Our lower horizontal water-ways and also the under sides of the middle horizontal water-ways are direct horizontal surface. Together they exceed in area the surface in the crown sheet of a horizontal sectional heater, and besides this we have all the direct surface in the tubes connecting the lower and middle water-ways, whose effectiveness every one will admit.

But this question of vertical or horizontal surface must be considered in connection with another of equal importance, viz., the circulation of water. If horizontal fire surface with horizontal circulation of water will absorb a certain percentage of the heat units produced; and if the circulation can then be made vertical without lessening the efficiency of the fire surface, every unprejudiced engineer will admit that the percentage of heat utilized will be largely increased. This we have done. The water circulation is almost entirely vertical, and we have a combination of horizontal and vertical surface which is more effective than any known arrangement of either horizontal or vertical surface alone above the same sized grate.

There is another point in this connection which should not be overlooked. Horizontal sections have flat upper surfaces on which soot readily collects, and unless these surfaces are frequently cleaned the soot more or less prevents the heat

from reaching the iron. In the entire Henderson Thermo heater there is less flat surface upon which soot can accumulate than in a single horizontal section.

The Water Joints. The sections in the Henderson Thermo heater are connected at their lower ends with the water base and at their upper ends with the top header by slip nipples. The castings are drawn together by short bolts located outside of the water ways, as shown by the engraving on page 15. These joints are easy to make tight, easy to take apart and durable. They are all outside of the fire, and in case repairs should ever be necessary are accessible without disturbing any other portion of the apparatus.

In 1891 the slip nipple was first used in heaters. At that time most of the heater manufacturers used the gasket joint. In nearly all the new heaters brought out since then the slip nipple is used and in most of the old ones it has been substituted for the gasket. This is satisfactory evidence of its excellence. From extensive experimenting and the experience acquired from many years' actual use of slip nipples made of various metals, we are convinced that malleable iron makes the best nipple. It yields to compression as cast iron does not and makes a joint that is less liable to leak. Moreover, it will not rust as tight to the sections as a cast iron nipple and the joint is more easily taken apart. In heaters which have been in use several years with cast nipples the parts are often so firmly rusted together that it is almost impossible to remove a section without breaking it. By the use of special automatic machinery we insure uniformity in size and finish.

The Heater Base. The sides and back of the base are three hollow castings, connected together by two five-inch slip nipples, and forming a continuous water-way into which the return pipes are

brought and with which the sections are connected. The return openings are in the back of the base, and the space in rear of the heater not occupied by the smoke-pipe is utilized for the return pipes, leaving the sides of the heater free for easy access to the joints, and for the removal of the sections if repairs should ever be necessary. The engraving on page 29 shows the location of the return openings and the manner of connecting the base sides with the base back. This sectional construction allows the base to be taken apart on the job and carried through small or circuitous passage ways, and, what is perhaps of greater importance, it removes the liability of breakage when in use, common to the single casting type.

The engraving on page 15 shows the water-ways in the sides and back of the base; the surface that is exposed to the heat in the ash-pit; how we have displaced the unsightly drums or headers common in vertical sectional heaters, reducing the width of the heater about one and one-half feet, and saving the heat such headers radiate into the cellar; and the improvement in the general appearance of the heater incident to these changes. While we do not count the inside of the base as heating surface there are times when there is considerable heat in the ash-pit, and the water in the base must necessarily absorb some heat which would otherwise be radiated into the heater room.

The Grate. The grate is of the rocking and dumping type. The bars rock in both directions a sufficient distance to thoroughly remove all ashes and clinkers. The rocking is limited by a pawl attached to the ash-pit front and engaging with the shaking lever. The throwing of this pawl out of position, as shown in the right hand grate on page 23 permits the turning of the grate bars on edge, when the contents of the fire-pot will drop into the ash-pit without any escape of dust into the furnace room.

Rocking grates with interlocking fingers are unsatisfactory, owing to their liability to stick and their tendency to waste fuel. To provide for the expansion of the grate bars, space must be allowed for some lateral movement, and this makes it possible for adjoining bars to move in opposite directions, so that with interlocking fingers the spaces between them will not be uniform, some being very small and others so large that good coal will fall through into the ash-pit. The fingers of our grate do not interlock, but clear each other so that sticking is impossible and the space between the bars is uniform under all conditions, small enough to prevent wasting

HENDERSON THERMO HEATER 41-INCH GRATE

of coal, yet ample for the admission of an adequate supply of air. The grate is so constructed that the rocking of the grate bars will not displace them. When repairs are necessary, a bar can be removed by turning it to the dumping position and removing the bolt that fastens it to the shaking lever.

The entire grate, with frame, can be removed for repairs by taking off part of the ash-pit front, as shown in the engraving on page 25.

The grates in the four largest sizes of the heater are 41 inches wide. A grate bar of this length, to be durable, must

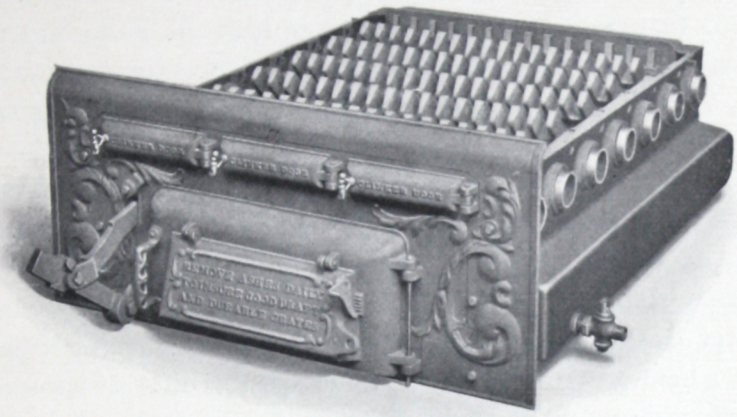
be made so heavy that it would be difficult to operate. We therefore use two grates in these four sizes only, as shown in the engraving on page 25. These are more easily operated, more durable, less expensive to repair or replace, and in every other respect equal to the single grate. For all smaller sizes of the heater the grate is single.

Some manufacturers make heaters with grates nine feet long from front to back. The cleaning of the rear portion of such a long grate is so difficult that attendants will neglect it; ashes will accumulate and make that portion of the grate valueless. The grate in our largest heater is only 54 inches long, and can be easily and thoroughly cared for by the ordinary attendant.

The ash-pit is of sufficient size to make it unnecessary to remove the ashes more than once in twenty-four hours. Daily removal is the best way to prevent excessive accumulation and the consequent burning of the grate.

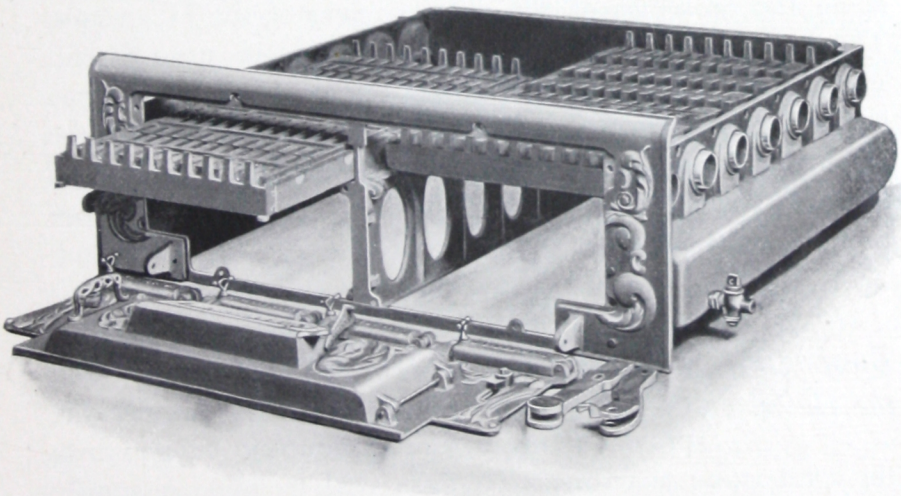
Capacity. In designing a heating plant the first thing is to determine the quantity of radiating surface required. Engineers are agreed that the surface should be sufficient to afford the desired heat in coldest weather with a water temperature of 180 degrees at the heater. Pipes connecting radiators with heater give off heat in the same way as radiators unless they are covered with non-conducting material, and their surface must be added to that in the radiators in estimating the demand upon the heater. Suppose the total of radiating surface in pipes and radiators amounts to 850 square feet. A heater is then required with capacity to supply water to 850 feet of radiation, maintaining 180 degrees at the heater.

If the heater is too small it may still be made to heat the water to 180 degrees, but it will do so only by constant forcing of the fire which means extravagant consumption of fuel. Again, the heater may have capacity to supply water



Single grate of heaters Nos. 628, 728, 828, 928

The same style is used in Nos. 419, 519, 619, 719



Double grate of heaters Nos. 741, 841, 941, 1041, showing how grate may be removed for repairs

at the proper temperature to 850 square feet of radiation, but the 850 feet may not be sufficient to heat the building with the water at 180 degrees. Here the water must be heated above 180 degrees and this again requires hard firing and waste of fuel.

For these reasons it is generally advisable to select a heater having rather more capacity than the radiation requires, but if the heater have too much excess capacity it will be quite as wasteful of fuel as if the capacity were a little scant. A heater does its best work when the fire is burning freely and just before it reaches the stage called forcing. If we force the draft, too much of the heat goes up the chimney. On the other hand, if we check the draft too much, combustion is so incomplete that unburned gases go up the chimney, and this is just what happens if the heater has too much excess capacity, because, in order to avoid excessive heat in ordinary weather, a very slow fire must be maintained. Therefore the best results are obtained from a given quantity of fuel when the heater is neither too small nor too large. On page 36 are given the capacities of the different sizes of the Henderson Thermo heater, and in fixing the ratings we gave careful attention to the foregoing considerations. If the size of the heater is determined in accordance with our table and the accompanying explanations, it will do its work easily at all times without forcing, and with less fuel than has heretofore been thought possible.

Burning all the Gases.

A special feature of the Henderson heaters, and one which is alone sufficient to establish their superiority over other heaters, is the provision made for introducing oxygen into the combustion chamber. To burn coal or wood a supply of oxygen is necessary. As the coal or wood burns, rich fuel gases are formed which will pass unused through the heater unless mixed with oxygen in the right proportion, at the right

temperature and in the right place. The quantity usually furnished is limited to that contained in the air passing through the grate and fuel. About twenty-three per cent. of this air is oxygen, but the supply thus afforded is entirely inadequate for three reasons, viz.: the obstruction offered by the body of fuel in the furnace makes it impossible to pass a sufficient volume of air through it; the air in passing over the incandescent fuel loses a large portion of its oxygen; and, the short time the gases are retained in the furnace, and the fact that they travel in the same direction as the air makes impossible the chemical union which constitutes ignition. Therefore, in the ordinary heater a very large percentage of the gases is not burned at all and good fuel goes up the chimney. In the case of soft coal we have, in addition to this waste, the objectionable black smoke that perfect combustion does away with.

The gas or smoke consumer, shown in the engraving on page 9, consists of cast-iron air tubes extending horizontally along each side of the fire-pot about on a level with the top of the coal. These tubes are supplied with air through openings at each side of the feed door, having adjustable swinging covers for regulating the supply. The air enters these openings, passes through the highly heated tubes, and discharges at a high temperature, through the small openings in the tubes, into the fire-pot. As the gases rise from the burning fuel the heated air mixes with them at the right time and in the best manner to furnish the oxygen required for perfect combustion. The gases are all burned, and a large quantity of heat is utilized which in other constructions would be wasted. The shape of these tubes, the thick metal of which they are made and the extraordinary provisions for their expansion insure durability. They will burn out in the course of time, but the expense of new ones is very slight and they can be put in place in a few minutes by any one competent to care for the heater.

The principle embodied in our Gas Consumer has been

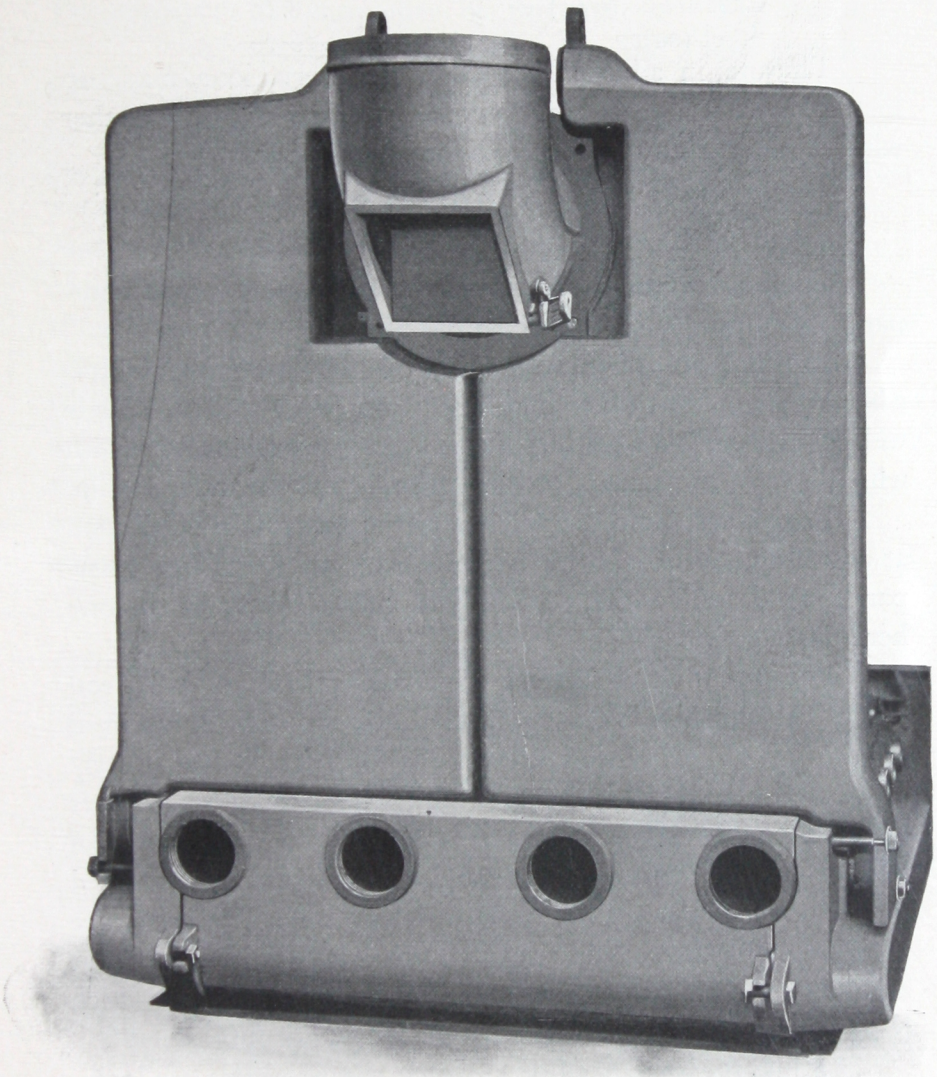
extensively used with excellent results in power boilers. It is impossible to attain as good results in a house heating boiler as in a power boiler, owing principally to the difference in the temperature of the fires. Notwithstanding this, when anthracite coal is used a decided saving is effected, according to the size of the plant, the attendance, etc. With soft coal there is a still greater saving, the smoke being consumed to such an extent that as it leaves the flue it has the appearance of smoke from a wood fire; the fire does not need such close attention nor do the flues require such frequent cleaning.

Material.

Twenty-five years ago fully 80 per cent. of all heaters manufactured in this country, for hot water and low pressure steam heating, were made of wrought iron or steel. To-day 90 per cent. are made of cast iron. This change has resulted from the gradual recognition of the advantages of cast iron for this purpose. It is far more durable than either wrought iron or steel, because less affected by corrosion. Rust quickly attacks the outer surfaces of wrought iron or steel, eating away the metal with increasing rapidity until its usefulness is destroyed. This action is very much slower in cast iron. While wrought-iron heaters have been known, under favorable conditions, to last twenty-five years, such cases are very exceptional. They seldom last more than fifteen years and their average life is much less. Wrought-iron boilers used for power purposes have longer life, but it is because they are in use all the year round, and it is during the summer, when house heaters are not in use, that the rust does its work.

It was found by Mallet, by taking pieces of metal similar in size and exposing them to the action of the weather under exactly similar conditions, that the "Loss in pounds per square foot of surface per annum," was, for:

Cast iron (green sand) . .	.050
Wrought iron (average 17 pieces)	.138
Steel (average 7 pieces) . .	.117



No. 741 HENDERSON THERMO HEATER

Showing how the base sides and base back are connected, the return openings, and the back of the heater

In like manner Gruner found the loss to be, for:

Cast iron (gray) . . .28 to .37
Steel (soft) . . . .56 to .75

Thwaite, in addition to his own observations, made up his tables from a great many averages of the above, together with those of many others, and he gives the loss for:

Cast iron as 045
Wrought iron as 187
Steel as 133

These observations establish beyond question the comparative immunity of cast iron from rust.

Another important advantage of cast iron is the fact that it is a better conductor of heat than wrought iron or steel. This is well known and has an important bearing on the facility with which heat is transmitted through the iron to the water within.

The parts of a cast-iron heater can be exactly duplicated at any time, and it is comparatively easy to substitute a new part for a defective one, especially in such a heater as the one here described.

The Henderson heaters are made entirely of cast iron except the slip nipples made of malleable iron which are used for the joints. It is well known that in heaters made partly of wrought and partly of cast iron, the wrought-iron parts exposed to the air or gases are the first to give out. In heaters having outside headers the wrought-iron threaded nipple connections are exposed to the air. As a consequence they are soon affected by rust. In our joints the two castings are drawn tight against each other over the slip nipple which is nowhere exposed either to the air or the burning gases.

In low pressure heating systems the pressures are insignificant. For steam the average is less than two pounds, and in water systems there is no pressure except the weight of the water in the apparatus. All parts of the Henderson heaters are of such shape and size as to withstand very severe pressures, and are subjected to a test of one hundred pounds before leaving the factory.

Durability. Every possible means has been taken to ensure the durability of this heater. The features that make it durable may be briefly stated as follows: the use of cast iron, the general advantages of which we have already explained; the twin sections and their peculiar design which leaves them entire freedom to expand; the absence of broad flat surfaces in contact as explained on page 8; the dividing of the base, which removes all liability of its cracking; the accuracy of our machine work, which allows every part to go to its place without strain; the character of the joints which are the most durable known; the perfection of our patterns which ensures uniform thickness of metal; the severe tests to which all castings are subjected; and finally, the fact that every inch of surface with which heat comes in contact, except the doors and the grate bars, has water behind it.

Ease of Setting up the Heater. The Henderson Thermo heater is very easy to erect. The base and grate are shipped put together, ready to set on the foundation. When necessary, for convenience in handling, the grate can be removed and the base taken apart. The largest part of the largest sized heater can be taken through an opening seven by twenty-five inches. The largest sections can be easily handled by a man and his helper. The water joints are easily and quickly made and in case they leak can be tightened without disturbing a single casting. The liability of leaks developing when the fire is started, or of imperfect fitting of the parts is reduced to a minimum by the severe test to which we subject the castings and the accuracy of our machine work.

The Plate Front. The engraving on page 7 shows the heater with one-half of the plate front removed. This plate front gives a handsome and finished appearance to the heater. It is bolted to

the front section in such a way that it is not affected by the expansion of the sections, and its durability is further assured by the fact that it is not subjected to the direct heat of the fire.

All Parts Interchangeable.

One cause of the breaking of heater castings when in use is the strain due to their having been forced into their places in putting the heater together. It is therefore important that the heater be so made that it will go together easily and be free from undue strains. All parts of the Henderson Thermo heater are made on the interchangeable plan by machinery specially designed for the work. This ensures the easy going together of all the parts and their entire freedom from severe strains. The convenience to the fitter of having the parts interchangeable cannot be too strongly emphasized. Any top header in our stock, having the proper number of openings, will go readily to place in any heater of corresponding size, and the openings will come with absolute precision in the right places for the connections. The same is true of the base and of every section. Any part for a heater of given size will fit in its place in any other heater of that size. If our patterns were scattered all over the world and a heater base was made and machined in Cuba, the sections in China, the top header in Australia and the grate in Africa, they could all be shipped to one point and the heater would go together as easily as if it had been already mounted in our factory.

Cleaning the Heater.

A heater does its work much more economically if it is kept clean, because accumulations of soot on the fire surface prevent the heat from reaching the iron. The best way to insure a clean heater is to make the cleaning easy. The surface in the Thermo heater is all self-cleaning except that in the upper vertical tubes, and this can be easily reached

with a brush through the clean-out doors. There are only a few small places where soot can accumulate, and by means of a special steel wire brush, furnished with the heater, all the interior surfaces can be thoroughly and easily cleaned and the soot will fall into the fire-pot.

Draining the Heater. By means of a draw-off cock in the base, every particle of water can be readily drawn from the heater.

Testing. We test all castings with cold water at a pressure of 100 pounds to the square inch, and while the metal is still cold the castings are filled with steam at a temperature of 337 degrees. The extent and suddenness of the change of temperature to which the castings are thus subjected constitute a far more severe test than they will ever meet in actual use.

Asbestos Covering. We furnish with each heater sufficient asbestos to provide a covering one inch thick for the entire heater except the front. This prevents radiation of heat in the basement just as effectively as a brick wall and takes up very much less room. Where a heater is bricked in the wall must be broken down and rebuilt if it becomes necessary to remove any part of the heater for repairs, while the asbestos covering can be easily removed from any part of the heater and easily replaced.

Fuel. The proper size of hard coal to be used in a heater depends largely upon the draft. In general, the stronger the draft the smaller the coal that may be used with advantage.

With draft of average strength a mixture of small egg and stove coal, in equal quantities, generally gives the best results. Small egg alone often works well in the larger

heaters if the draft is not too strong, and stove coal may be used alone if the draft is not too weak. Sometimes, with exceptionally strong draft, chestnut or pea coal may be used with advantage. Our grates are suitable for coal of any size except pea coal for which we furnish special grates if desired.

Soft Coal. Our heaters give excellent results with any soft coal of fair quality. Many of them are in use with this fuel and the users report the most satisfactory service. One man tried four heaters of different make before he found a soft coal heater to his mind in the Henderson Thermo. The gas consuming device described elsewhere is particularly valuable with this fuel. It not only economizes by burning a larger proportion of the gases but also saves trouble in cleaning the heater by consuming more of the products which are usually deposited on heating surfaces. More frequent cleaning is, of course, required than with hard coal but the arrangement of the flues makes cleaning easy.

For Greenhouse Heating. It is particularly important that any necessary repairs to a greenhouse heater may be made quickly, as great damage may result from failure of heat in cold weather. The quick repair features of the Henderson Thermo are especially valuable in such cases, because, as we have elsewhere explained, if a section should break temporary repairs can be made in a very short time, and heat maintained until a new section can be procured.

The superior durability of cast iron in the moist atmosphere of greenhouses is also an important consideration.

SUMMARY OF FEATURES.

Base. Three hollow castings connected by slip nipples. Shipped put together but easily taken apart if desired.

Sections. Twin construction in all sizes. Ensures freedom to expand and prevents breaking. Any half section removable without disturbing the rest of the heater. Sections easy to handle and pass through small openings.

Top Header. Sunk between upper ends of sections. Permits increase of fire surface without additional height.

Grate. Rocking and dumping, easily operated, easily removed, made double in large sizes.

Fire Surface. Direct surface vertical and horizontal, unusually large in proportion to grate, most effectively arranged. Flue surface properly proportioned to direct and heat strikes it at right angles.

Water Joints. Horizontal malleable iron slip nipples outside the fire. Easy to tighten, easy to take apart, durable.

Smoke Flues. So placed that no part of the combustion chamber is deprived of its proper share of heat. Upper flues staggered. Uniform proportion of flue area, fire surface and grate surface in all sizes.

Circulation. Vertical throughout. Water heats quickly in small columns, moves rapidly, no counter currents.

Gas Consumer. Saves fuel by burning all the gases.

Capacity. Ratings based on economical firing, not on forcing.

Durability. Every means taken to ensure it. No weak parts. All hollow castings tested under 100 pounds pressure to the square inch.

Easy to Set up. All parts interchangeable. Largest sections easily handled by man and helper. Water joints quickly made, and tightened any time without disturbing any casting.

Easy to Clean. Nearly all surface self-cleaning and all easily reached with a brush.

Draining. All water easily drawn from the heater.

PRICE LIST,

DIMENSIONS AND CAPACITIES

HENDERSON THERMO WATER HEATER

Heater No.	Gross radiation heater will carry —see opposite page	Price—including asbestos covering	Size of Grate	Flow Tappings (returns duplicate)	Diameter of Smoke-pipe	Shipping Weight	Telegraph Code
419	625	**$183**	19 × 18	2–4″	8	1975	Hazard
519	850	**226**	19 × 24	2–4″	8	2250	Haze
619	1100	**276**	19 × 30	2–4″	9	2525	Helm
719	1350	**326**	19 × 36	2–4″	9	2800	Hemlock
628	1700	**396**	28 × 30	3–4″	10	3200	Herald
728	2075	**472**	28 × 36	3–4″	12	3625	Hero
828	2475	**550**	28 × 42	3–4″	12	4050	Hickory
928	2900	**615**	28 × 48	3–4″	13	4475	Hitch
741	3250	**672**	41 × 36	4–4″	13	5000	Hive
841	3875	**760**	41 × 42	4–4″	15	5775	Hoard
941	4550	**860**	41 × 48	4–4″	15	6550	Hobby
1041	5300	**960**	41 × 54	4–4″	16	7300	Hornet

The number of sections is indicated by the first figure of the heater number; the width of the grate by the last two figures. A No. 419 has four sections and a 19-inch grate.

For additional dimensions see page 39.

☞ **To avoid mistakes in ascertaining the size of heater required according to our ratings it is absolutely necessary to read the explanations on the opposite page.**

EXPLANATION OF TABLE.

If mains are to be uncovered, first ascertain the square feet of radiating surface in all the piping for connecting radiators with heater. Add to this the number of square feet of direct cast-iron radiation in all the rooms. The total will be the heater capacity required according to our ratings. If pipe coils are anywhere used instead of cast-iron radiators, 25 per cent. should be added to the actual surface of the coils in making this calculation.

The mains will average about 25 per cent. of the total radiation in residences approximating the regulation square design and in those of a rectangular shape, when not unusually long in proportion to their width, and where the heater is pretty centrally located. This percentage will be increased when the heater is located at one end or corner of the building, and when the design is one requiring long runs.

If all the mains are thoroughly covered we recommend adding to the radiation in the rooms 40 per cent. of the actual surface in the mains. For example, a building requiring 400 feet of radiation, and the surface of the uncovered mains being 100 feet, a heater of 500 feet capacity would be used. If the mains were covered a 440-foot heater would do the work equally as well.

When indirect radiation is used, each foot should be counted as a foot and a half in estimating the heater capacity required, because the heater has to furnish as many heat units for one foot of indirect as for a foot and a half of direct radiation. For example, if a heater of 400-feet capacity would be used for supplying 400 feet of direct radiation, a 550-foot one would be necessary for supplying 100 feet of direct and 300 feet of indirect.

We base our rating on the use of a flue of proper construction and ample capacity. If the flue is not first-class, a larger heater will help, but the best way is to change the flue. Only those who have observed the comparative results from different flues can appreciate the effect of the flue upon the working of the heater.

We absolutely guarantee the ratings of our heaters, if the entire plant is properly constructed and operated, and the radiation is sufficient to heat the entire building in the coldest weather, with the temperature of the water at the heater 180°.

The material and workmanship are guaranteed only to the extent of our furnishing new castings for any found defective in manufacture.

We recommend some surplus capacity, for the reason that there is always a possibility of a shortage in radiation. In such a case surplus heater capacity is exceedingly desirable. With ample radiation for the requirements of the building, our heaters will economically carry their rating.

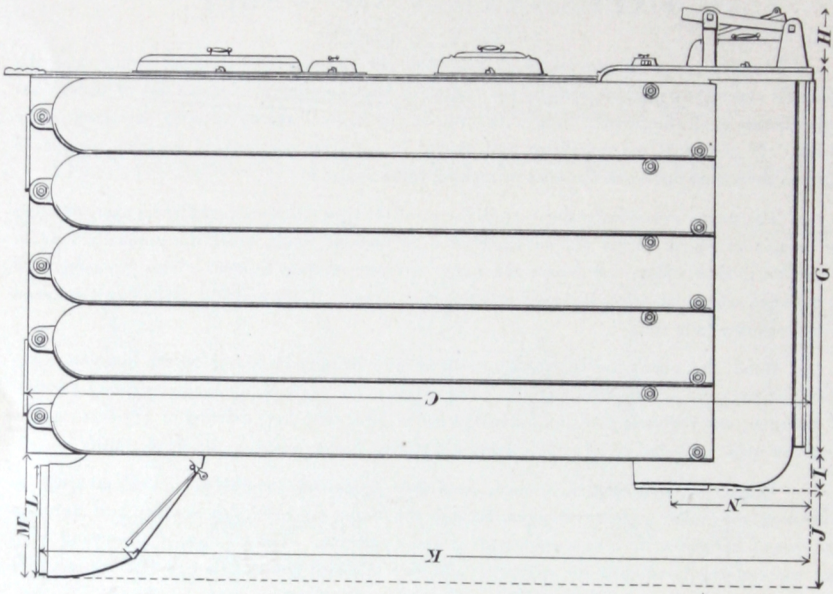
The heater when used as a tank heater for supplying water for domestic purposes will heat as many gallons of water from 40° to 200° as it will supply in square feet of direct radiation. When used for this purpose, and it is connected with a water-works system of high pressure, a pressure reducing walve should be placed in the cold water supply pipe.

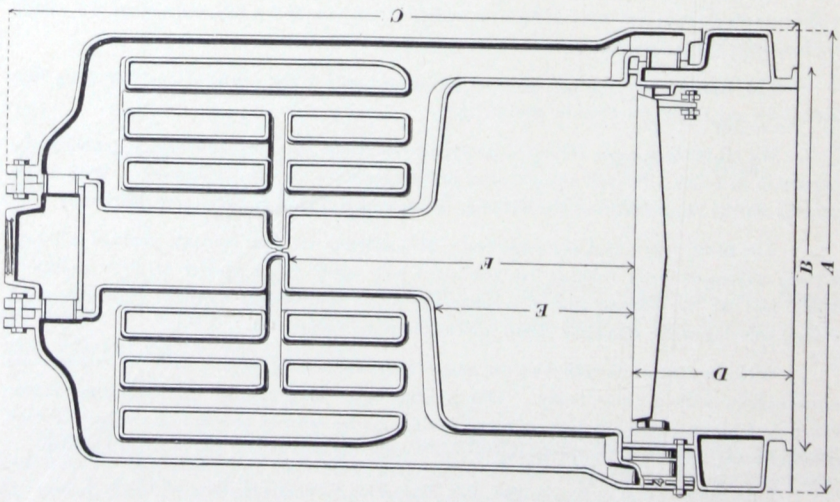
When desired we furnish with the heater an attachment for heating water for domestic use in connection with a range boiler. This is independent of the water in the heating system. When such an attachment is used additional heater capacity must be provided on the basis of each gallon of water heated per hour requiring as much boiler capacity as two feet of direct radiation.

Trimmings consist of Slicing Bar, Ash Hoe, Flue Brushes and Blow-off Cock.

All Water Heaters are tapped for Altitude Gauge and Thermometer.

Price includes asbestos cement for covering the entire heater except the front.





For measurements, see opposite page.

HENDERSON THERMO WATER HEATER.

To find any dimension of any sized heater, first look at the drawings on the opposite page and find the letter which indicates the measurement desired. Underneath that letter in the table, and opposite the number of the heater, will be found the measurement in inches.

Heater Number	A	B	C	D	E	F	G	H	I	J	K	L	M	N
419	29	22	64	13	16¾	29	25½	7	3	8½	62	8	11	11½
519	29	22	64	13	16¾	29	31½	7	3	8½	62	8	11	11½
619	29	22	64	13	16¾	29	37½	7	3	8½	60½	9	11	11½
719	29	22	64	13	16¾	29	43½	7	3	8½	60½	9	11	11½
628	38	31	64	13	16¾	29	37½	7	3	12	64	10	14½	11½
728	38	31	64	13	16¾	29	43½	7	3	12	64	12	14½	11½
828	38	31	64	13	16¾	29	49½	7	3	12	64	12	14½	11½
928	38	31	64	13	16¾	29	55½	7	3	12	62½	13	14½	11½
741	51	44	64	13	16¾	29	43½	7	3	12	62½	13	14½	11½
841	51	44	64	13	16¾	29	49½	7	3	15½	65	15	18	11½
941	51	44	64	13	16¾	29	55½	7	3	15½	65	15	18	11½
1041	51	44	64	13	16¾	29	61½	7	3	15½	63½	16	18	11½

HENDERSON THERMO STEAM HEATER

The circulation of water in a steam heater is altogether different from that in a water heater, and different internal construction is necessary to obtain the best results in the two systems. The efficiency of a water heater is increased by having the water-ways as small as good foundry practice will permit. In a steam heater larger water spaces must be provided. These facts are ignored by many manufacturers who sell the same heater for either water or steam. While it is true that any well designed steam heater may be used for water heating it cannot give as good results either in heating power or in economy of fuel, as a heater properly designed for water heating alone.

The engravings and text on the following pages show the differences in construction of our steam and water heaters.

No. 719 HENDERSON THERMO STEAM HEATER

Showing the complete heater

No. 728 HENDERSON THERMO STEAM HEATER

Showing the complete heater

No. 741 HENDERSON THERMO STEAM HEATER

Showing the complete heater

In the Henderson Thermo Heater the differing requirements of steam and hot water are met by changes in the form of the sections which make up the body of the heater.

The Steam Section. In a hot water apparatus the heater, piping and radiators are parts of a continuous circuit completely filled with water. As the water in the heater is warmed the colder water in the radiators and return pipes forces the heated and consequently lighter water through the flow pipes into the radiators, and a continuous circulation is established not only in the heater but through the entire system. The flow of water in the heater is always upward, and any downward currents would check the circulation. In a steam heater, on the contrary, downward water currents are essential. When fire is started in a steam heater there is no water in the apparatus above the water line of the heater. As the heat increases some of the water in the heater becomes warmer than the rest and currents are formed within the heater itself, the colder water moving downward and the warmer water upward. When the warmest water reaches a certain temperature little steam globules or bubbles are formed. They follow the upward current until they reach the surface of the water where they burst and the steam vapor within them is freed. The faster the up and down currents move the more rapidly is steam made, and anything which tends to delay this circulation within the heater lessens the generation of steam. In heaters as generally made the upward and downward currents must pass each other in the same chamber and the friction caused by their coming in violent contact with each other greatly retards the circulation.

Similar opposing currents are formed when water is heated in an ordinary tea kettle. A famous English inventor, Mr. Thomas Fletcher, conceived the idea that the tea

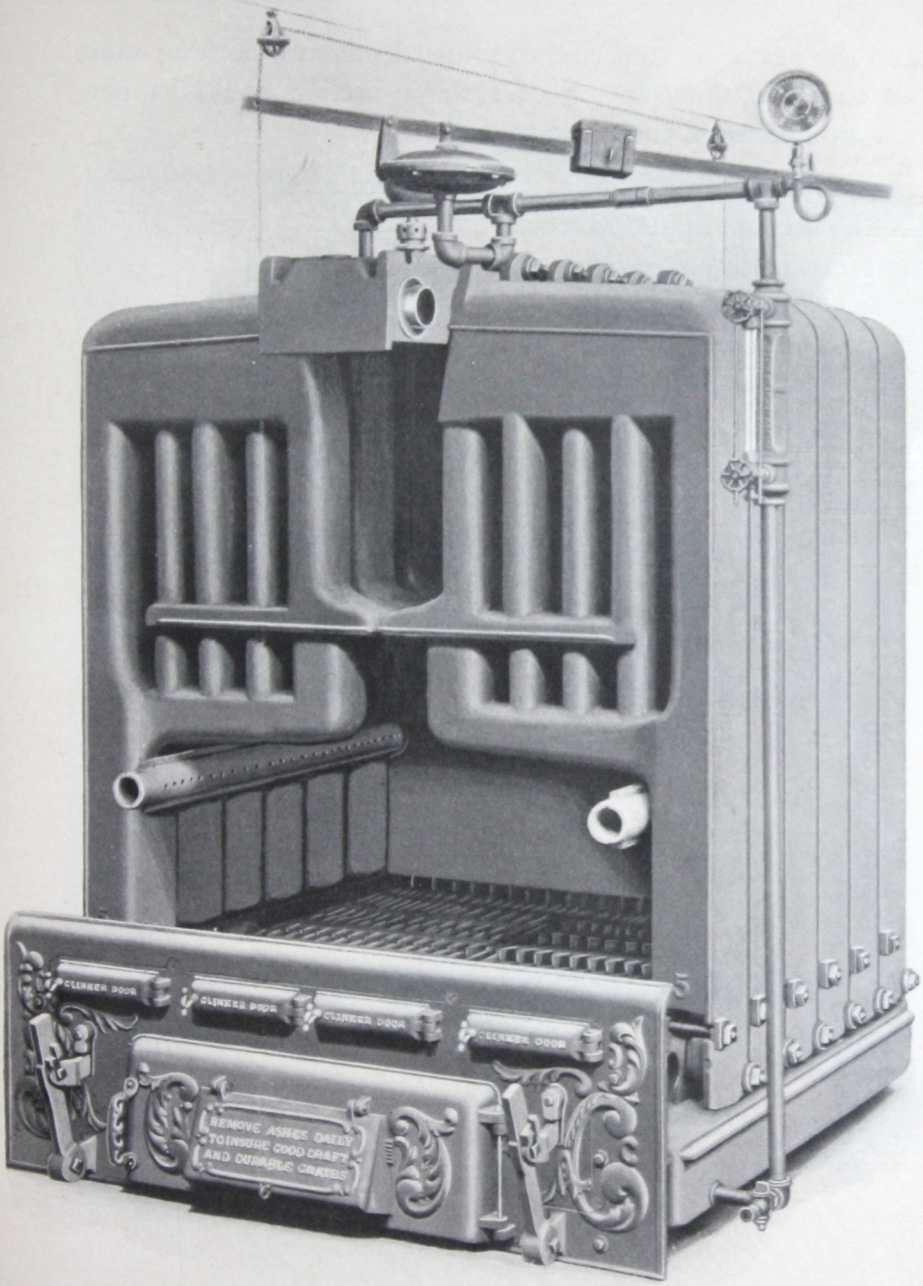
No. 741 HENDERSON THERMO STEAM HEATER

Half of the plate front removed, showing front section

kettle could be improved by placing in it a tube through which the downward current could move without coming in contact with the ascending current. He tried the experiment and found that the water circulated so much more rapidly that a given quantity was heated to the same temperature in one-third less time in a kettle with the tube than in one without it, the heat being furnished by burners of the same size and style, consuming the same quantity of gas per hour. This principle of construction is utilized in the Henderson Thermo Steam Heater, separate water-ways being arranged to provide for the ascending and descending currents.

The engraving on page 49 shows how this is done by means of a diaphragm which forms a double water-way in the outer vertical water-tube of each section. The water in the passage nearest the outside of the heater, not being directly in contact with the heat from the fire, is much cooler than the water in the rest of the section. Its movement is therefore downward at all times and under all conditions, while the water on the other side of the diaphragm ascends. The currents do not interfere with each other and a rapid circulation takes place within each section of the heater. This circulation is independent of the general circulation of steam and condensed water through the piping system. The general circulation does not even accelerate the circulation within the heater as it does in a water system. Hence the value of the arrangement described for facilitating the internal circulation. It makes the heater a more rapid steamer and, as in the case of the tea kettle, gives the same efficiency with a much smaller consumption of fuel.

Safety. In a steam heater sections are more likely to break than in a water heater. Our twin section construction is, therefore, of even more value here than in the water heater. If the safety valve should get out of order

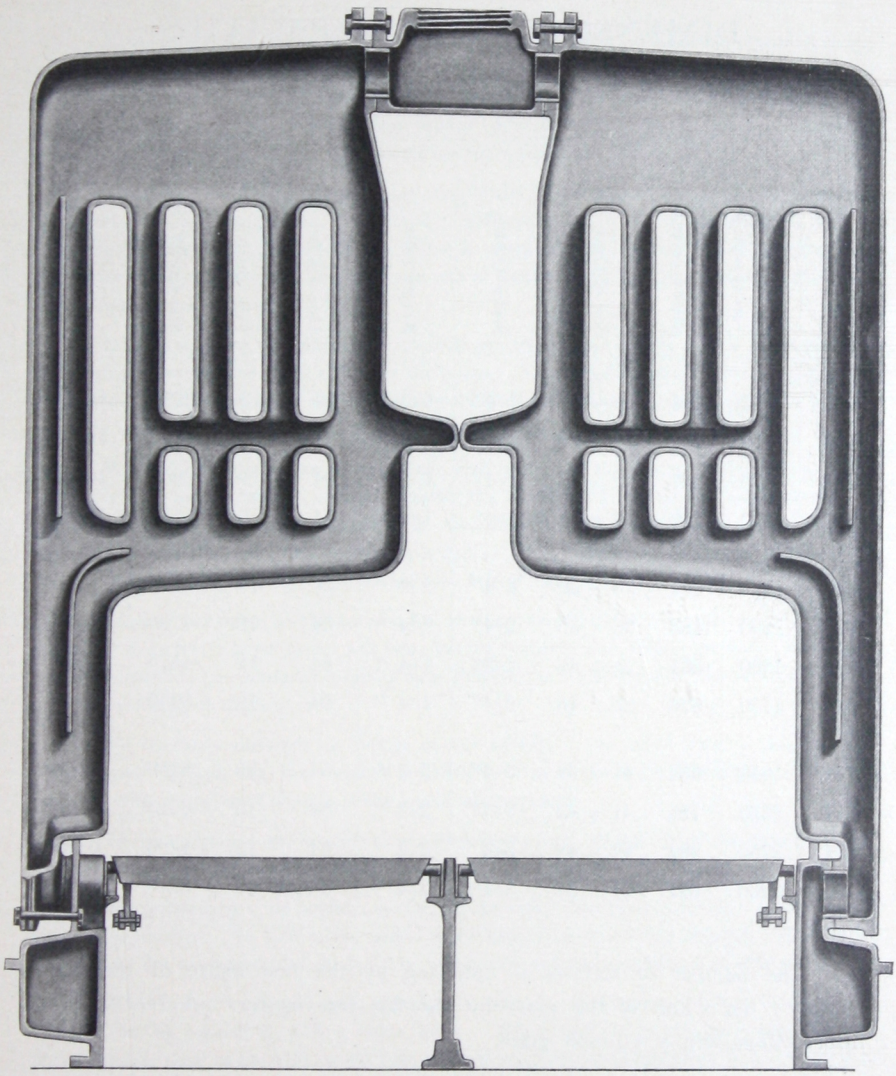


No. 741 HENDERSON THERMO STEAM HEATER

Plate front and front sections removed

and the heater be subjected to unusual pressure nothing more serious than the cracking of a single section could happen, and no explosion could occur.

With the exception of the difference in the construction of the sections, the difference in the flow and return tappings and the addition of the usual steam trimmings our steam heater is the same as the water heater and has all the advantages and improvements described in the foregoing pages. These advantages and improvements together with the steam sections make the Henderson Thermo the best steam heater ever designed, from the standpoints of both the dealer and the user. The water heater is not a steam heater put to a use for which it is not adapted, but is specially constructed for water heating and is unsurpassed for this purpose.



HENDERSON THERMO STEAM HEATER

Showing the water circulation and the slip nipple joints

PRICE LIST,
DIMENSIONS AND CAPACITIES
HENDERSON THERMO STEAM HEATER

Heater No.	Gross radiation heater will carry —see opposite page	Price—including asbestos covering	Size of Grate	Steam Outlets	Return Inlets	Height of Water Line—inches	Diameter of Smoke Pipe—inches	Shipping Weight	Telegraph Code
419	375	**$194**	19 × 18	1–4″	1–2½″	54	8	2250	Hencoop
519	510	**237**	19 × 24	1–4″	1–2½″	54	8	2550	Hermit
619	660	**287**	19 × 30	1–4″	1–2½″	54	9	2850	Herring
719	810	**337**	19 × 36	1–4″	1–2½″	54	9	3150	Hide
628	1025	**407**	28 × 30	2–4″	1–4 ″	54	10	3600	Hinder
728	1250	**483**	28 × 36	2–4″	1–4 ″	54	12	4100	Hollow
828	1500	**561**	28 × 42	2–4″	1–4 ″	54	12	4575	Hood
928	1750	**626**	28 × 48	2–4″	1–4 ″	54	13	5050	Horse
741	1950	**683**	41 × 36	3–4″	2–4 ″	54	13	5650	Hound
841	2325	**782**	41 × 42	3–4″	2–4 ″	54	15	6525	Humble
941	2750	**882**	41 × 48	3–4″	2–4 ″	54	15	7400	Hunter
1041	3200	**984**	41 × 54	3–4″	2–4 ″	54	16	8250	Hyena

The number of sections is indicated by the first figure of the heater number; the width of the grate by the last two figures. A No. 419 has four sections and a 19-inch grate.

For additional dimensions see page 53.

☞To avoid mistakes in ascertaining the size of heater required according to our ratings it is absolutely necessary to read the explanations on the opposite page.

Explanation of Heater Price List.

If mains are to be uncovered, first ascertain the square feet of radiating surface in all the piping for connecting radiators with heater. Add to this the number of square feet of direct cast-iron radiation in all the rooms. The total will be the heater capacity required according to our ratings. If pipe coils are anywhere used instead of cast-iron radiators, 25 per cent. should be added to the actual surface of the coils in making this calculation.

The mains will average about 25 per cent. of the total radiation in residences approximating the regulation square design and in those of a rectangular shape, when not unusually long in proportion to their width, and where the heater is pretty centrally located. This percentage will be increased when the heater is located at one end or corner of the building, and when the design is one requiring long runs.

If all the mains are thoroughly covered we recommend adding to the radiation in the rooms 40 per cent. of the actual surface in the mains. For example, a building requiring 400 feet of radiation, and the surface of the uncovered mains being 100 feet, a heater of 500 feet capacity would be used. If the mains were covered a 440-foot heater would do the work equally as well.

When indirect radiation is used, each foot should be counted as a foot and a half in estimating the heater capacity required, because the heater has to furnish as many heat units for one foot of indirect as for a foot and a half of direct radiation. For example, if a heater of 400-feet capacity would be used for supplying 400 feet of direct radiation, a 550-foot one would be necessary for supplying 100 feet of direct and 300 feet of indirect.

We base our rating on the use of a flue of proper construction and ample capacity. If the flue is not first-class, a larger heater will help, but the best way is to change the flue. Only those who have observed the comparative results from different flues can appreciate the effect of the flue upon the working of the heater.

We absolutely guarantee the ratings of our heaters, if the entire plant is properly constructed and operated, and the radiation is sufficient to heat the entire building in the coldest weather, with an indicated pressure at the heater of two pounds.

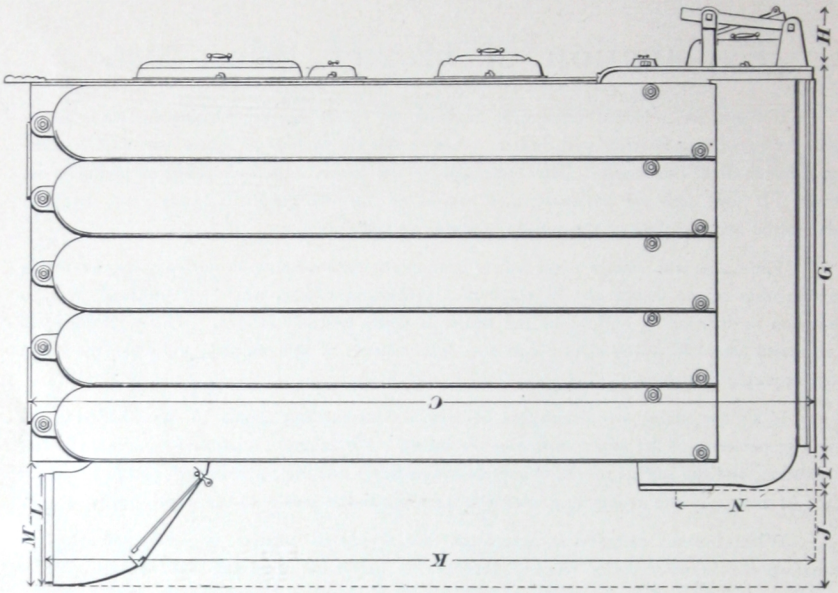
The material and workmanship are guaranteed only to the extent of our furnishing new castings for any found defective in manufacture.

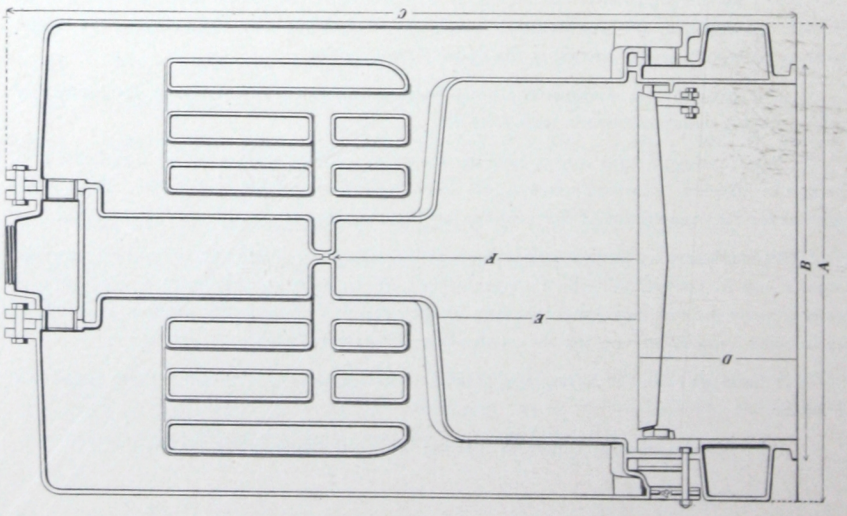
We recommend some surplus capacity, for the reason that there is always a possibility of a shortage in radiation. In such a case surplus heater capacity is exceedingly desirable. With ample radiation for the requirements of the building, our heaters will economically carry their rating.

When desired we furnish back sections with openings for inserting a coil to heat water for domestic use in connection with a range boiler. When such an attachment is used additional heater capacity must be provided on the basis of each gallon of water heated per hour requiring as much boiler capacity as one and one quarter feet of direct radiation.

Trimmings consist of Slicing Bar, Ash Hoe, Flue Brushes and Steam Trimmings shown on heater.

Price includes asbestos cement for covering the entire heater except the front.





For measurements, see opposite page.

HENDERSON THERMO STEAM HEATER

To find any dimension of any sized heater, first look at the drawings on the opposite page and find the letter which indicates the measurement desired. Underneath that letter in the table, and opposite the number of the heater, will be found the measurement in inches.

Heater Number	A	B	C	D	E	F	G	H	I	J	K	L	M	N
419	29	22	64	13	16¾	24½	25½	7	3	8½	62	8	11	11½
519	29	22	64	13	16¾	24½	31½	7	3	8½	62	8	11	11½
619	29	22	64	13	16¾	24½	37½	7	3	8½	60½	9	11	11½
719	29	22	64	13	16¾	24½	43½	7	3	8½	60½	9	11	11½
628	38	31	64	13	16¾	24½	37½	7	3	12	64	10	14½	11½
728	38	31	64	13	16¾	24½	43½	7	3	12	64	12	14½	11½
828	38	31	64	13	16¾	24½	49½	7	3	12	64	12	14½	11½
928	38	31	64	13	16¾	24½	55½	7	3	12	62½	13	14½	11½
741	51	44	64	13	16¾	24½	43½	7	3	12	62½	13	14½	11½
841	51	44	64	13	16¾	24½	49½	7	3	15½	65	15	18	11½
941	51	44	64	13	16¾	24½	55½	7	3	15½	65	15	18	11½
1041	51	44	64	13	16¾	24½	61½	7	3	15½	63½	16	18	11½

Height from floor to top of steam trimmings 73 inches in all sizes.

GENERAL TELEGRAPHIC CODE

For use in connection with the Code Words of the Price Lists.

Gage	Quote prices on.
Gain	How soon can you ship?
Galena	Can ship immediately.
Gallant	Can ship in.....days.
Galeon	F. O. B. Reading, terms 30 days, or less 2% for Cash in 10 days.
Galley	With car load freight allowance to.....
Gambler	With full freight allowance to.....
Garb	With freight allowance to equal shipment from.....
Garner	Ship immediately by freight.
Garnish	Ship immediately by express.
Gaudy	Get ready for immediate shipment, will send shipping instructions by mail.
Gaunt	We have received your order of.....
Gavel	We cannot accept your order of.....
Gender	We accept your order of.....
Genial	Have you shipped our order of.....
Gentle	If order has not been shipped.
Geyser	Change our order to read.
Glacier	Add to our order of.....
Gleam	When will order of.....be shipped?
Glitter	Ship what you can at once.
Goblet	Your order was shipped.
Gossip	Trace shipment of.....

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HENDERSON
WATER
AND
STEAM
HEATERS